NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
SOUTH DAKOTA SUPPLEMENTS ITALICIZED

WINDBREAK/SHELTERBELT ESTABLISHMENT

(ft.)
CODE 380

DEFINITION

Linear plantings of single or multiple rows of trees or shrubs established for environmental purposes.

PURPOSES

Reduce wind erosion.

Protect growing plants.

Manage snow.

Provide shelter for structures and livestock.

Provide wildlife habitat.

Provide a tree or shrub product.

Provide living screens.

Improve aesthetics.

Improve irrigation efficiency.

CONDITIONS WHERE PRACTICE APPLIES

On any areas where woody plants are suited.

CRITERIA

General Criteria Applicable To All Purposes Named Above

The location, layout and density of the planting will accomplish the purpose and function intended within a 20-year period.

The maximum design height (H) for the windbreak or shelterbelt shall be the expected height of the tallest row of trees or shrubs at age 20 for the given site. *Heights may be estimated based on: 1) performance of the individual species (or comparable species) in nearby areas or similar sites; or 2) predetermined and documented heights using Section II of the South Dakota Technical Guide (SDTG), Windbreak Suitability Groups (WSG).*

Unless state, county, or township regulations differ, the windward row of plantings on the north and west sides of roads will be a minimum of 160 feet from the shoulder. For plantings on the south and east sides of roads, the windward row will be a minimum of 100 feet from the shoulder, and the row nearest the road should be at least 1 1/2 times its mature height from the edge of the road.

The planting will be protected from adverse impacts such as livestock damage or fire.

Avoid planting trees or shrubs where they will interfere with structures or any above or below ground utilities.

Species Selection

Species must be suitable and adapted to the soils, climate and purpose. *See Windbreak Suitability Groups in Section II of the SDTG for a detailed listing of species suited to the soils at the site.*

Generally, plan to use a single species in a row except where soil type dictates a change or where species to be mixed are compatible. See Table 1, Guide to Compatible Species.

Plantings of three or less rows will have a different species in each row. This specification does not apply to conifer species. Plantings of 4 to 10 rows must not contain more than 2 rows of the same deciduous species unless soil conditions limit the choice of species.

Windbreak Design

Windbreak design density will vary based on the planned function of the barrier. Windbreak density is a function of the number of rows in the planting, the species and spacing used, and the season (leaf on versus leaf off).

1. ***Spacing between rows***

Spacing between adjacent rows can vary or be uniform. If plantings are to be cultivated, plan the row spacing four feet wider than the width of the cultivation equipment. Maximum row spacings will depend on site conditions and planned barrier function but will not exceed 22 feet. Optimum between the row spacing is 12 to 16 feet. Spacing in excess of 16 feet will require continuous cultivation of a portion or most of the planting for the life of the planting.

2. ***Spacing within row***

Spacing between plants within any given row is generally uniform, unless species changes occur. Planting density recommendations are:

Plant Types/Heights	*Plant to Plant Spacing in Ft.*
Shrubs (less than 10 ft. in height)	*3 - 6*
Midsize broadleaf trees (10 – 25 ft. in height)	*6 – 10*
Cedar or Juniper	*6 - 10*
Pine/Spruce	*6 – 10*
Med. to tall broadleaf (greater than 25 ft. in height)	*8 – 12*

When plantings exceed the minimum design criteria through the use of additional rows, plant to plant spacings up to 16 feet may be planned for appropriate species.

When maximum spacings are planned, emphasize with the land user, the importance of replacing dead trees.

Closer spacings, both between rows and within rows, result in providing protection in a shorter period of time. Where appropriate, plantings with narrow spacings can be designed with a thinning recommended to achieve the ultimate density.

Maintain an isolation strip for the life of the planting. The minimum width of the isolation strip will be eight feet for unfenced plantings. For fenced plantings, the minimum width of the isolation strip will be equal to the average row spacing or to the width of the cultivation equipment plus four feet.

3. ***Twin Row-High Density Designs***

Twin row-high density plantings may be used as an alternative design in appropriate settings. This design will consist of two closely spaced rows (four to six feet) using the same species in each set of paired rows.

The use of multiple twin rows can be very effective in reducing snow loading. Spacing between sets of twin rows can vary from 25 to 50 feet to achieve the desired objective.

Planting Stock

Only viable, high quality, and adapted planting stock or seed will be used. *Planting stock must be of known origin. Superior named varieties are recommended over common varieties and should be used when they are available. Common varieties are approved for use; however, care needs to be taken that seedlings are grown from locally adapted seed sources. See Table 2 for guidance on caliper, age, and height requirements.*

Planting Site Preparation

Site preparation shall be sufficient for establishment and growth of selected species and appropriate for the site. Planting sites shall be properly prepared based on the soil type and vegetative conditions encountered. Avoid sites that have had recent applications of pesticides harmful to woody species. *Apply* pesticides only when needed. Handle *according to* federal, state, and local regulations, *and properly dispose of empty containers.* Follow all label directions and precautions listed on containers.

1. ***Requirements for arable sites (land that is tilled or tillable)***

The land on which trees and shrubs will be planted must be essentially free of sod and perennial weeds before planting. The following site preparations are required:

a. Soddy sites:

Applicable for all Technical Guide areas. Planting sites in moisture-depleting cover such as sod, sweet clover, or alfalfa are to be tilled (moldboard plow, disk plow, rototiller or similar equipment) by

July 1 of the year prior to the planting of the windbreak/shelterbelt. All sod for the entire site will be destroyed during the summer fallow period. Fall seeded temporary cover may be used where needed to control erosion.

Note: Primary noxious weeds must be controlled in accordance with state and local regulations before the windbreak is planted.

Instead of tillage, sod may be killed by non-selective herbicides the year prior to tree planting. Plant trees and shrubs in the killed sod. On heavy soils, narrow tillage strips may be necessary in the killed residue to achieve a satisfactory planting when a tree-planting machine is used.

On sandy sites (WSG's 5 and 7) that require protective cover because of serious susceptibility to soil blowing, sod may be killed by nonselective herbicides in a strip at least 36 inches wide the year prior to tree planting. Plant trees in the center of the strip.

b. *Small grain or row crop stubble sites:*

i. *For the Eastern and East Central Technical Guide areas, the planting site may be prepared in the fall or in the same spring as the tree planting is made.*

If the site is small grain stubble, or clean tilled row crop, and it is reasonably free of weeds, trees and shrubs may be planted in the stubble without prior preparation.

It may be necessary to till a narrow strip to kill weeds or volunteer grain, or to prevent stalks and other residue from clogging the tree planter. If fabric mulch or other mulch materials are to be installed, till in the spring before planting.

Tillage on steep slopes must be on the contour or cross-slope. A cover crop or stubble must be maintained between the rows to control erosion and sediment deposition on planted stock or to protect the trees from soil blowing on sandy sites.

ii. *For the Western, West Central, and Black Hills Technical Guide areas, the site must be summer fallowed by July 1 of the year prior to planting, unless a determination is made which indicates that moisture conditions are favorable to plant without fallowing.*

If it is determined that moisture conditions are favorable for planting without summer fallow, the planting site may be prepared in the fall or in the same spring as the tree planting is made.

If the site is small grain stubble, or clean tilled row crop, and it is reasonably free of weeds, trees and shrubs may be planted in the stubble without prior preparation.

It may be necessary to till a narrow strip to kill weeds or volunteer grain, or to prevent stalks and other residue from clogging the tree planter. If fabric mulch or other mulch materials are to be installed, till in the spring before planting.

Tillage on steep slopes must be on the contour or cross-slope. A cover crop or stubble must be maintained between the rows to control erosion and sediment deposition on planted stock or to protect the trees from soil blowing on sandy sites.

2. ***Nonarable sites and/or erosive sites***

On those sites where it is not practical or possible to operate equipment (because of steepness or other limitations), where tillage of the entire site will cause excessive erosion or where tillage of the entire site is

impractical, the following methods of site preparation may be used:

Machine or hand scalp an area at least 36 inches in diameter and plant in the center of the scalped area.

Rototill a strip at least 36 inches wide the year prior to tree planting and plant in the center of the tilled area.

Kill the vegetation in a 36-inch diameter or larger area or in a 36-inch or wider strip with a nonselective herbicide the year prior to tree planting and plant in the center of the treated area.

Planting in competing vegetation without first killing it with tillage or herbicides is not allowed under this standard.

Application of fabric weed barrier over living sod is not a suitable site preparation method. Fabric weed barrier is applied for in row weed control, or moisture conservation after the trees are planted.

3. ***Site preparation methods that may be used to establish odd area or wildlife plantings on nonarable sites.***

   a. *An alternative method of site preparation on WSG's 5 and 7 sites that are in native grass sod is to plant trees in a shallow furrow 2 to 4 inches deep and at least 18 inches wide. The sod should be thrown to both sides. The furrow should be prepared immediately prior to or as part of the planting operation. Plantings on this site shall be limited to conifers. Suitable broadleaf trees and shrubs can be used on WSG 5 sites if six-foot wide fabric mulch is installed. Native shrubs can be used on WSG 7 site if six-foot wide fabric mulch is installed. See Mulching (484) specification for installation procedures.*

   b. *Hand planting on sod sites using rooted stock.*

      i. *Planting must be accomplished in the approximate center of a site on which the sod has been cleared.*

      ii. *Cleared site must be 36 inches in diameter.*

      iii. *Depth of cleared site – two to four inches.*

      iv. *Place cleared sod on down slope side of clearing.*

      v. *Planting should be done with a tree planting bar, tile spade, or pointed clay shovel.*

   c. *Hand planting on wet soils using willow or cottonwood cuttings.*

      Planting may be accomplished using hand planting equipment or by directly inserting the cutting in the soil. The planting site need not be cleared of vegetation

Planting

The planting shall be done at a time and manner to insure survival and growth of selected species.

All plantings shall be made between the time in the early spring when the frost leaves the soil and June 1st. Bare root conifers should be planted by May 15th.

Plant only when air temperatures are above freezing.

Plant seedings in nearly vertical position with root collars at or about one inch below the soil surface.

Pack soil around seedlings to eliminate air pockets.

Protect roots of seedlings from drying during all operations.

Do not plant on hot, windy days to avoid excessive drying.

Moisture conservation or supplemental watering shall be provided for plant establishment and growth where natural precipitation is too low for the selected species.

Geo-textile fabric, tree mats, and other appropriate organic mulch materials may be used for weed control and moisture conservation for new plantings on all sites.

Acceptable mulches, fabric, or mat materials must allow for water infiltration and air movement. Fabric mats will be a minimum of three feet by three feet in size and properly secured. Manufactured fabrics and tree mats must have a serviceable life span of at least 36 months.

When organic mulches are used, the material shall be placed in a minimum four-inch deep layer and at least a two-foot wide radius around the seeding. Organic mulches should be kept at least six inches away from the main stem of trees and shrubs.

Care and maintenance

Control competitive vegetation in the planting until the ground surface is shaded by the trees and shrubs during the growing season. Generally, this means a minimum of three years of weed control after the date of planting.

Control the weeds in the row with a within-the-row cultivator, over the row cultivator, hand hoeing, herbicides, or plastic mulch (weed barriers). Do not cultivate deeper than three inches.

Control the weeds between the row with a shovel, sweep-type cultivator, or tandem disk. To avoid damage to tree roots, do not cultivate deeper than three inches.

If fabric mulch is used in the row, control the weeds between rows with tillage or herbicides. Use caution when doing tillage to avoid snagging the fabric mulch.

Continue cultivation until August 15.

On untilled sites mow between the rows approximately once each month during the growing season.

Replace all dead seedlings annually for at least two years after the planting is made.

Inspect the windbreak periodically to monitor adverse impacts such as pest infestations or pesticide use on adjacent lands. Take the necessary steps to protect the planting. Harmful pests present on the site shall be controlled or eliminated as necessary.

Additional Criteria To Reduce Wind Erosion; Protect Growing Plants

The windbreak will be oriented as close to perpendicular to the troublesome wind as possible. The interval between windbreaks shall be determined using current, approved, wind erosion technology to achieve the quality level for the soil or plant resource. The distance sheltered by the barrier shall be 10 times the design height (H).

The wind erosion control system should consider temporary measures to supplement the windbreak until it is fully functional.

Any design of one or more rows is acceptable for a field windbreak.

Additional Criteria To Manage Snow

The windbreak will be oriented as close to perpendicular to the snow-bearing wind as possible.

For snow **distribution**, the maximum windbreak density will be 35 percent and the interval between barriers will not exceed 20H.

For snow **accumulation**, the minimum barrier density will be 50 percent and the windward row will be at least 160 feet from the area to be protected.

Windbreaks will be located so that snow deposition will not adversely impact the area to be protected.

If possible, extend the planting 100 feet beyond the protected area so snow eddying around the ends does not impact the protected area.

Living snow fence - windward row 160 to 250 feet from the shoulder of the road. Minimum of three rows to provide the necessary density.

Additional Criteria To Provide Shelter For Structures And Livestock

The planting will be oriented as close to perpendicular to the troublesome wind as possible.

For wind protection, the minimum barrier density will be 65 percent. *All areas needing primary protection should be located* within 10H of the design height *of the tallest tree row.*

Primary plantings are required on the north and west sides of primary areas in need of protection (PAP). The windward row must be a minimum of 200 feet from the PAP, except where ownership or soil conditions restrict the planting.

Minimum number of rows required for primary plantings to provide a minimum of 65 percent density and the space required to store drifted snow in the windbreak:

- *six rows in Major Land Resource Areas (MLRAs) 54, 58D, 60A, 61, 62, 63A, and 64.*
- *seven rows in MLRAs 102A, 102B, 55B, 55C, 53B, 53C, 63B, and 66.*

Each of the following conditions will reduce the number of rows required for adequate protection by one:

1. *A snow trap of one or more rows of shrubs planted 100 feet windward and parallel to the primary planting.*

2. *A field windbreak located less than 660 feet windward and parallel to the primary planting.*

3. *Planting one of the first two windward rows to conifers.*

A primary planting using the twin-row high-density design will consist of three or more sets of twin rows in all MLRAs for primary plantings. The same species should be used in both rows of a set, at least one set should contain conifers.

Secondary plantings can be planted on the south and east sides of PAP. The windward row should be a minimum of 100 feet from the PAP, except where ownership or soil conditions restrict the planting.

Any design of one or more rows is acceptable for a secondary planting.

Plant one or more twin row sets for secondary plantings. The same species should be used in both rows of a set.

Additional Criteria To Provide Wildlife Habitat

To enhance the wildlife value of plantings, plant two or more rows of shrubs, shrub like trees, or conifers on the leeward side of multi-row plantings. Include fruit producing shrubs where possible.

In multiple row plantings, containing more than three rows, the leeward rows may be planted in groups or segments containing five or more plants of one species in a series to enhance wildlife values.

Additional Criteria For Screens

Noise screens shall be dense, as tall as, and as close to the noise source as practicable.

Visual screens shall be located as close to the observer as possible.

Additional Criteria To Improve Aesthetics

Use tree and shrub species with attractive form, foliage color, and flowers.

Include conifers and other colorful species in the planting.

CONSIDERATIONS

Spacing between windbreaks and rows of windbreaks may be adjusted, within limits of the criteria above, to accommodate widths of equipment.

Selection of plants for use in windbreaks should favor species or varieties tolerant to herbicides used in the area.

Plants that may be alternate hosts to undesirable pests should be avoided.

All plantings should compliment natural features.

Where water erosion and/or runoff from melting snow is a hazard, it should be controlled by supporting practices.

Wildlife needs should be considered when selecting tree or shrub species.

Species diversity should be considered to avoid loss of function due to species specific pests.

Consideration should be given to adverse offsite effects.

Consult the Pest Management standard for guidance where pesticides will be used.

PLANS AND SPECIFICATIONS

Specifications for this practice shall be prepared for each site. Specifications shall be recorded using approved specifications sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance):

Replacement of dead trees or shrubs will be continued until the barrier is functional.

Vegetative competition will be controlled.

Supplemental water will be provided as needed.

Thin the barrier to maintain its function.

Damaging pests will be monitored and controlled.

TABLE 1. GUIDE TO COMPATIBLE SPECIES

DECIDUOUS (BROADLEAF) TREES			
Group 1	*Group 2*	*Group 3*	*Group 4*
Green Ash *Honeylocust* *Hackberry*	*Common chokecherry* *Crabapples* *Russian-olive*	*Cottonwoods* *Hybrid poplars*	*Siberian elm* *(Do not alternate with any other tree or shrub species)*
CONIFEROUS TREES			
Group 5	*Group 6*		
Black Hills spruce *Blue spruce* *Ponderosa pine* *Scotch pine* *Austrian pine*	*Eastern redcedar* *Rocky Mountain juniper*		
DECIDUOUS (BROADLEAF) SHRUBS		*DECIDUOUS (BROADLEAF) TREES AND SHRUBS*	
Group 7	*Group 8*	*Group 9* [1]	
Late lilac *Lilac* *Peking cotoneaster* *Siberian peashrub* *European cotoneaster*	*American plum* *Redosier dogwood* *Silver buffaloberry*	*Trees:* *Bur oak* *Green ash* *Hackberry* *Crabapples* *Honeylocust*	*Shrubs:* *Lilac* *Siberian peashrub* *Peking cotoneaster* *European cotoneaster* *Amur honeysuckle*

[1] *Any tree can be alternated with any shrub in this group.*

TABLE 2 - SUGGESTED NURSERY STOCK GRADES

	Caliper 1 inch above root collar (In inches)		*Desirable Height Range*	*Age*
	Minimum	*Maximum*	*(In inches)*	*(In years)*
Shrubs	*3/16"*	*1/2"*	*12-24"*	*1-0, 2-0*
Cedar or Juniper	*3/16"*	*3/8"*	*8-12"*	*3-0, 1-2, 2-1*
Midsize broadleaf	*3/16"*	*1/2"*	*12-24"*	*1-0, 2-0*
Pine	*7/32"*	*3/8"*	*6-12"*	*2-0, 2-1, 2-2*
Spruce	*7/32"*	*1/2"*	*6-10"*	*2-2*
Mid to Tall broadleaf	*3/16"*	*1/2"*	*12-24"*	*1-0, 2-0, 3-0*
Rooted Cuttings [1]	*1/4"*	*5/8"*	*16-24"*	*1-0*

[1] *Rooted cuttings include cottonwoods, poplars, and willows.*

Suggested Row Arrangement For Different Size Primary Windbreaks

Width of Belt in Rows	*6*	*8*	*10*	*12*
		(Row Numbers)		
Shrubs	*1-2-6*	*1-2-7-8*	*1-2-7-8-9-10*	*1-2-7-8-9-10-11-12*
Cedar or Juniper	*1-2-5-6*	*1-2-7-8*	*1-2-7-8-9-10*	*1-2-7-8-9-10-11-12*
Midsize broadleaf trees	*2-3-4-5-6*	*2-3-4-7-8*	*2-3-4-5-6-7-8-9-10*	*2-3-4-5-6-7-8-9-10-11-12*
Pine/Spruce	*1-5-6*	*1-6-7-8*	*1-6-7-8-9-10*	*1-7-8-9-10-11-12*
Med. to tall broadleaf trees	*3-4-5*	*3-4-5-6*	*3-4-5-6-7*	*3-4-5-6-7-8*

Row 1 is in the windward or outside row in relation to the area protected. For a 3-, 5-, 7-, 9-, or 11-row windbreak, eliminate row 3 of a 4-, 6-, 8-, 10-, or 12-row windbreak in the above table.

Because most snow pack is stored within the first seven rows of a windbreak, rows eight on up should contain drought tolerant species.

Russian-olive, crabapple, and amur maple are examples of midsize broadleaf trees.

Green ash, hackberry, and bur oak are examples of tall broadleaf trees.

Tall broadleaf trees may be omitted from wildlife plantings.

Twin row high-density design

Planting rows: Set 1 is the windward row, Set 2 should be 25-50 feet away from Set 1, Set 3 should be 35-50 feet from Set 2, and 35-50 feet away from Set 4.

	Suitable Sets
Shrubs	*1-4*
Cedar or Juniper	*1-2-3-4*
Midsize broadleaf trees	*2-4*
Pine	*1-3-4*
Spruce	*3-4*
Med. to tall broadleaf trees	*2-3*

Additional twin-row sets can be added leeward of Set 4 at a distance of 25 - 50 feet between sets.

The species listed as suitable for Set 4 can be repeated in any additional sets leeward.